

# Course ID: ECE 440 Introduction to Computer Networks-Spring

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## Homework #2

### 1. Problem P4, Chapter 2 (40%)

Consider the following string of ASCII characters that were captured by Wireshark when the browser send an HTTP GET message. Answer the following questions, indicating where in the HTTP GET message below you find the answer.

```
GET /cs453/index.html HTTP/1.1<cr><lf> Host: gaia.cs.umass.edu<cr> User-Agent: Mozilla/5.0 (Windows; U; Windows NT 5.1; en-US; rv:1.7.2) Gecko/20040804 Netscape/7.2 (ax) <cr><lf> Accept: ext/xml, application/xml, application/xhtml+xml, text/html;q=0.9, text/plain; q=0.8, image/png, */*, q=0.5<cr><lf> Accept-Language: en-us, en;q=0.5<cr><lf> Accept-Encoding: zip, deflate<cr><lf> Accept-Charset: ISO-8859-1, utf-8; q=0.7, *; q=0.7<cr><lf>Keep-Alive: 300 Connection:keep-alive
```

(a) What is the URL of the document requested by the browser?

/cs453/index.html

(b) What version of HTTP is the browser running?

HTTP/1.1

(c) Does the browser request a non-persistent or a persistent connection?

persistent

(d) What is the IP address of the host on which the browser is running?

IP cannot be determined from the GET request

(e) What type of browser initiates this message? Why is the browser type needed in an HTTP request message?

Mozilla/5.0 The type of browser determines the type of content to send (i.e. command line vs. mobile vs. desktop).

### 2. Problem P5, Chapter 2 (30%)

The text below shows the reply sent from the server in response to the HTTP GET message in the question above. Answer the following questions, indicating where in the message below you find the answer.

```
HTTP/1.1 200 OK<cr><lf>Date: Tue, 07 Mar 2008 12:39:45GMT<cr><lf>Server: Apache/2.0.52 (Fedora) <cr><lf>Last-Modified: Sat, 10 Dec 2005 18:27:46 GMT<cr><lf>Etag: "526c3-f22-a88a4c80" Accept-Ranges: bytes<cr><lf>Content-Length: 3874<cr><lf>Keep-Alive: timeout=max=100 Connection: Keep-Alive<cr><lf>Content Type: text/html; charset=ISO-8859-1<cr><lf><cr><lf><!doc type html public "-//w3c//dtd html 4.0transitional//en"><lf><html><head><meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1"><meta name="GENERATOR" content="Mozilla/4.79 [en] (Windows NT 5.0; U) Netscape]"><lf> <title>CMPSCI 453 / 591 / NTU-ST550ASpring 2005 home-page</title><lf></head><lf> <much more document text following here (not shown)>
```

(a) Was the server able to successfully find the document or not? What time was the document reply provided?

Yes, the request was successful. Tue, 07 Mar 2008 12:39:45 GMT

(b) When was the document last modified?

Sat, 10 Dec 2005 18:27:46 GMT

(c) How many bytes are there in the document being returned?

3874 bytes

- (d) What are the first 5 bytes of the document being returned? Did the server agree to a persistent connection?

The first five bytes returned were <!doc. Yes, the server agreed to the persistent connection.

### 3. Problem P22, Chapter 2 (30%)

Consider distributing a file of  $F=15$  Gbits to  $N$  peers. The server has an upload rate of  $u_s = 30Mbps$ , and each peer has a download rate of  $d_i = 2Mbps$  and an upload rate of  $u$ . For  $N = 10, 100$ , and  $1000$  and  $u = 300Kbps, 700Kbps$ , and  $2Mbps$ , prepare a chart giving the minimum distribution time for each of the combinations of  $N$  and  $u$  for both client-server distribution and P2P distribution.

$$\text{end-to-end}_{C-S} = \max \left\{ \frac{NF}{u_s}, \frac{F}{d_{min}} \right\}$$

$$\max_{N=10} \left\{ \frac{(10)(15 \times 10^9)}{30 \times 10^6} = 5000s, \frac{15 \times 10^9}{2 \times 10^6} = 7500s \right\} = 7500s$$

$$\max_{N=100} \left\{ \frac{(100)(15 \times 10^9)}{30 \times 10^6} = 50000s, \frac{15 \times 10^9}{2 \times 10^6} = 7500s \right\} = 50000s$$

$$\max_{N=1000} \left\{ \frac{(1000)(15 \times 10^9)}{30 \times 10^6} = 500000s, \frac{15 \times 10^9}{2 \times 10^6} = 7500s \right\} = 500000s$$

$$\text{end-to-end}_{P2P} = \max \left\{ \frac{F}{u_s}, \frac{F}{d_{min}}, \frac{NF}{u_s + \sum_{i=1}^N u_i} \right\}$$

$$\max_{N=10, u_i=300} \left\{ \frac{(15 \times 10^9)}{30 \times 10^6} = 500s, \frac{15 \times 10^9}{2 \times 10^6} = 7500s, \frac{(10)(15 \times 10^9)}{30 \times 10^6 + 10 \times 300 \times 10^3} = 4545.5s \right\} = 7500s$$

$$\max_{N=100, u_i=300} \left\{ \frac{(15 \times 10^9)}{30 \times 10^6} = 500s, \frac{15 \times 10^9}{2 \times 10^6} = 7500s, \frac{(100)(15 \times 10^9)}{30 \times 10^6 + 100 \times 300 \times 10^3} = 25000s \right\} = 25000s$$

$$\max_{N=1000, u_i=300} \left\{ \frac{(15 \times 10^9)}{30 \times 10^6} = 500s, \frac{15 \times 10^9}{2 \times 10^6} = 7500s, \frac{(1000)(15 \times 10^9)}{30 \times 10^6 + 1000 \times 300 \times 10^3} = 45455s \right\} = 45455s$$

$$\max_{N=10, u_i=700} \left\{ \frac{(15 \times 10^9)}{30 \times 10^6} = 500s, \frac{15 \times 10^9}{2 \times 10^6} = 7500s, \frac{(10)(15 \times 10^9)}{30 \times 10^6 + 10 \times 700 \times 10^3} = 4054s \right\} = 7500s$$

$$\max_{N=100, u_i=700} \left\{ \frac{(15 \times 10^9)}{30 \times 10^6} = 500s, \frac{15 \times 10^9}{2 \times 10^6} = 7500s, \frac{(100)(15 \times 10^9)}{30 \times 10^6 + 100 \times 700 \times 10^3} = 15000s \right\} = 15000s$$

$$\max_{N=1000, u_i=700} \left\{ \frac{(15 \times 10^9)}{30 \times 10^6} = 500s, \frac{15 \times 10^9}{2 \times 10^6} = 7500s, \frac{(1000)(15 \times 10^9)}{30 \times 10^6 + 1000 \times 700 \times 10^3} = 20548s \right\} = 20548s$$

$$\max_{N=10, u_i=2000} \left\{ \frac{(15 \times 10^9)}{30 \times 10^6} = 500s, \frac{15 \times 10^9}{2 \times 10^6} = 7500s, \frac{(10)(15 \times 10^9)}{30 \times 10^6 + 10 \times 2000 \times 10^3} = 4054s \right\} = 7500s$$

$$\max_{N=100, u_i=2000} \left\{ \frac{(15 \times 10^9)}{30 \times 10^6} = 500s, \frac{15 \times 10^9}{2 \times 10^6} = 7500s, \frac{(100)(15 \times 10^9)}{30 \times 10^6 + 100 \times 2000 \times 10^3} = 6521s \right\} = 7500s$$

$$\max_{N=1000, u_i=2000} \left\{ \frac{(15 \times 10^9)}{30 \times 10^6} = 500s, \frac{15 \times 10^9}{2 \times 10^6} = 7500s, \frac{(1000)(15 \times 10^9)}{30 \times 10^6 + 1000 \times 2000 \times 10^3} = 7389s \right\} = 7500s$$

# 1. The Basic HTTP GET/response interaction

1. Is your browser running HTTP version 1.0 or 1.1? What version of HTTP is the server running?

HTTP/1.1

2. What languages (if any) does your browser indicate that it can accept to the server?

en-us

3. What is the IP address of your computer? Of the gaia.cs.umass.edu server?

192.168.0.6 and 128.119.245.12

4. What is the status code returned from the server to your browser?

200 OK

5. When was the HTML file that you are retrieving last modified at the server?

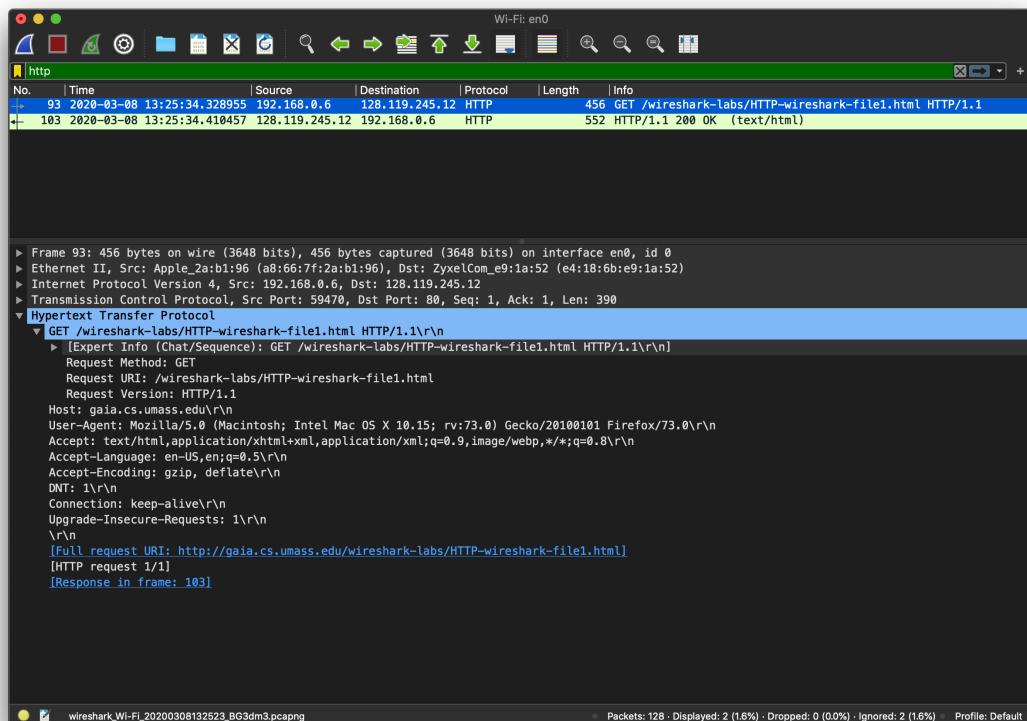
Sun, 08 Mar 2020 06:59:03 GMT

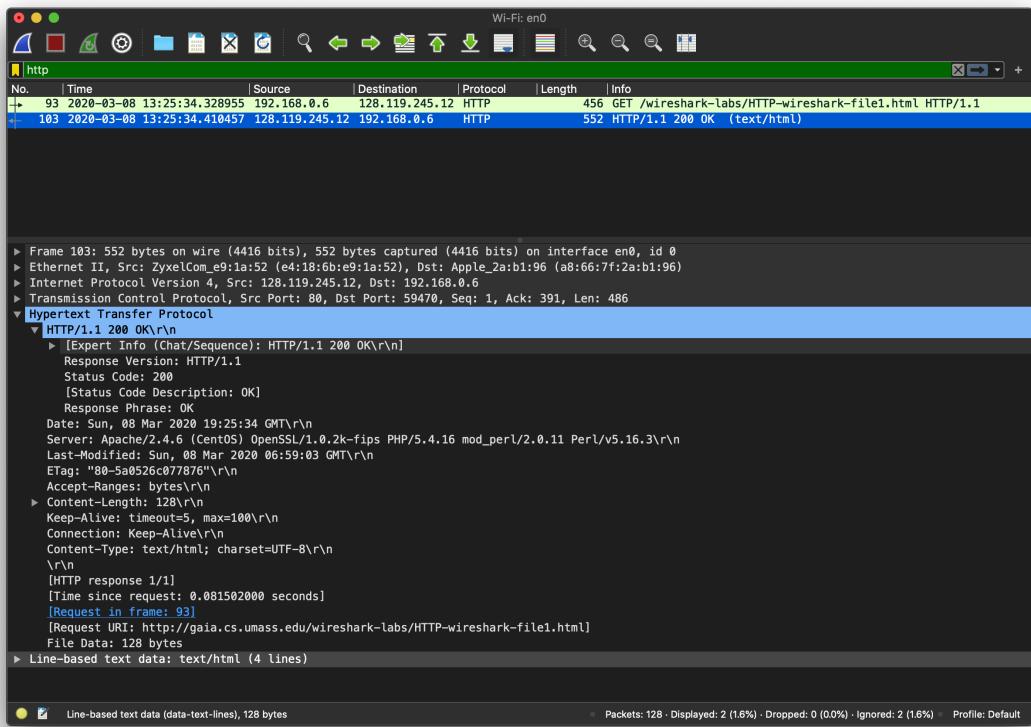
6. How many bytes of content are being returned to your browser?

128

7. By inspecting the raw data in the packet content window, do you see any headers within the data that are not displayed in the packet-listing window? If so, name one.

I don't see any headers displayed in the packet content window that aren't also displayed in the packet-listing window.





## 2. The HTTP CONDITIONAL GET/response interaction

8. Inspect the contents of the first HTTP GET request from your browser to the server. Do you see an “IF-MODIFIED-SINCE” line in the HTTP GET?

No, there is not an IF-MODIFIED-SINCE line.

9. Inspect the contents of the server response. Did the server explicitly return the contents of the file? How can you tell?

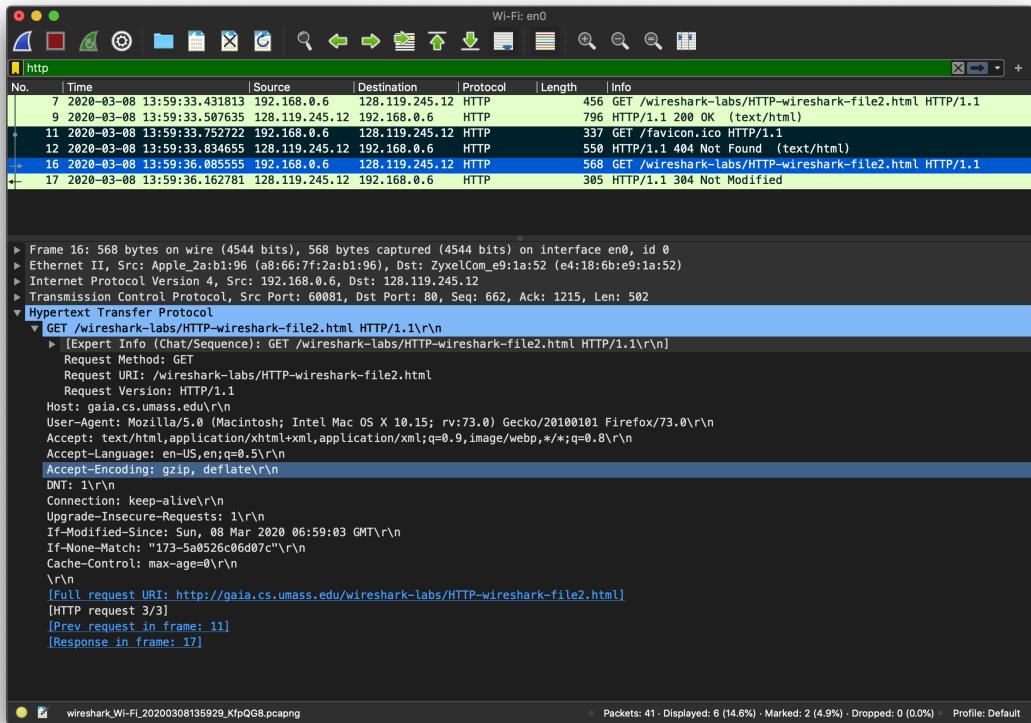
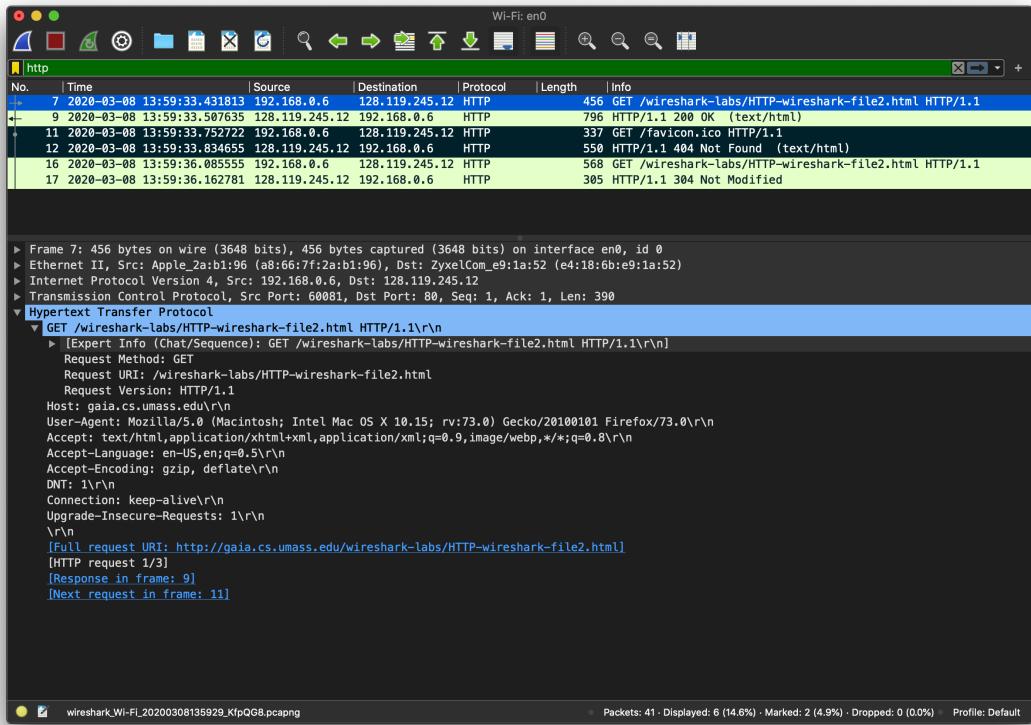
Yes, the server explicitly returned the contents of the file. The contents are shown below.

10. Now inspect the contents of the second HTTP GET request from your browser to the server. Do you see an “IF-MODIFIED-SINCE:” line in the HTTP GET? If so, what information follows the “IF-MODIFIED-SINCE:” header?

Yes, there is an IF-MODIFIED-SINCE line in the HTTP GET. The header value is: Sun, 08 Mar 2020 06:59:03 GMT.

11. What is the HTTP status code and phrase returned from the server in response to this second HTTP GET? Did the server explicitly return the contents of the file? Explain.

The HTTP status code and phrase returned from the server is: 304 Not Modified and the server did not return the contents of the file because the contents have not been modified since the last request and are still cached locally.



Wi-Fi: en0

http

No.	Time	Source	Destination	Protocol	Length	Info
7	2020-03-08 13:59:33.431813	192.168.0.6	128.119.245.12	HTTP	456	GET /wireshark-labs/HTTP-wireshark-file2.html HTTP/1.1
9	2020-03-08 13:59:33.507635	128.119.245.12	192.168.0.6	HTTP	796	HTTP/1.1 200 OK (text/html)
11	2020-03-08 13:59:33.752722	192.168.0.6	128.119.245.12	HTTP	337	GET /favicon.ico HTTP/1.1
12	2020-03-08 13:59:33.834655	128.119.245.12	192.168.0.6	HTTP	556	HTTP/1.1 404 Not Found (text/html)
16	2020-03-08 13:59:36.085555	192.168.0.6	128.119.245.12	HTTP	568	GET /wireshark-labs/HTTP-wireshark-file2.html HTTP/1.1
17	2020-03-08 13:59:36.162781	128.119.245.12	192.168.0.6	HTTP	305	HTTP/1.1 304 Not Modified

```

HTTP/1.1 200 OK\r\n
Date: Sun, 08 Mar 2020 19:59:33 GMT\r\n
Server: Apache/2.4.6 (CentOS) OpenSSL/1.0.2k-fips PHP/5.4.16 mod_perl/2.0.11 Perl/v5.16.3\r\n
Last-Modified: Sun, 08 Mar 2020 06:59:03 GMT\r\n
ETag: "173-5a0526c06d07c"\r\n
Accept-Ranges: bytes\r\n
Content-Length: 371\r\n
Keep-Alive: timeout=5, max=100\r\n
Connection: Keep-Alive\r\n
Content-Type: text/html; charset=UTF-8\r\n
\r\n
[HTTP response 1/3]
[Time since request: 0.075822000 seconds]
[Request in frame: 7]
[Next request in frame: 11]
[Next response in frame: 12]
[Request URI: http://gaia.cs.umass.edu/wireshark-labs/HTTP-wireshark-file2.html]
File Data: 371 bytes
▼ Line-based text data: text/html (10 lines)
  \n
  <html>\n  \n
  Congratulations again! Now you've downloaded the file lab2-2.html. <br>\nThis file's last modification date will not change. <p>\nThus if you download this multiple times on your browser, a complete copy <br>\nwill only be sent once by the server due to the inclusion of the IN-MODIFIED-SINCE<br>\nfield in your browser's HTTP GET request to the server.\n  \n
  </html>\n
  
```

Packets: 41 - Displayed: 6 (14.6%) - Dropped: 0 (0.0%) - Profile: Default

Wi-Fi: en0

http

No.	Time	Source	Destination	Protocol	Length	Info
7	2020-03-08 13:59:33.431813	192.168.0.6	128.119.245.12	HTTP	456	GET /wireshark-labs/HTTP-wireshark-file2.html HTTP/1.1
9	2020-03-08 13:59:33.507635	128.119.245.12	192.168.0.6	HTTP	796	HTTP/1.1 200 OK (text/html)
11	2020-03-08 13:59:33.752722	192.168.0.6	128.119.245.12	HTTP	337	GET /favicon.ico HTTP/1.1
12	2020-03-08 13:59:33.834655	128.119.245.12	192.168.0.6	HTTP	556	HTTP/1.1 404 Not Found (text/html)
16	2020-03-08 13:59:36.085555	192.168.0.6	128.119.245.12	HTTP	568	GET /wireshark-labs/HTTP-wireshark-file2.html HTTP/1.1
17	2020-03-08 13:59:36.162781	128.119.245.12	192.168.0.6	HTTP	305	HTTP/1.1 304 Not Modified

```

Frame 17: 305 bytes on wire (2440 bits), 305 bytes captured (2440 bits) on interface en0, id 0
Ethernet II, Src: ZyxelCom_e9:1a:52 (e4:18:6b:e9:1a:52), Dst: Apple_2a:b1:96 (a8:66:7f:2a:b1:96)
Internet Protocol Version 4, Src: 128.119.245.0, Dst: 192.168.0.6
Transmission Control Protocol, Src Port: 80, Dst Port: 60081, Seq: 1215, Ack: 1164, Len: 239
▼ Hypertext Transfer Protocol
  ▼ HTTP/1.1 304 Not Modified
    ▶ [Expert Info (Chat/Sequence): HTTP/1.1 304 Not Modified\r\n]
      Response Version: HTTP/1.1
      Status Code: 304
      [Status Code Description: Not Modified]
      Response Phrase: Not Modified
      Date: Sun, 08 Mar 2020 19:59:36 GMT\r\n
      Server: Apache/2.4.6 (CentOS) OpenSSL/1.0.2k-fips PHP/5.4.16 mod_perl/2.0.11 Perl/v5.16.3\r\n
      Connection: Keep-Alive\r\n
      Keep-Alive: timeout=5, max=98\r\n
      ETag: "173-5a0526c06d07c"\r\n
      \r\n
      [HTTP response 3/3]
      [Time since request: 0.077226000 seconds]
      [Prev request in frame: 11]
      [Prev response in frame: 12]
      [Request in frame: 16]
      [Request URI: http://gaia.cs.umass.edu/wireshark-labs/HTTP-wireshark-file2.html]
      
```

wireshark\_Wi-Fi\_20200308135929\_KfpQG8.pcapan

Packets: 41 - Displayed: 6 (14.6%) - Marked: 2 (4.9%) - Dropped: 0 (0.0%) - Profile: Default

### 3. Retrieving Long Documents

12. How many HTTP GET request messages did your browser send? Which packet number in the trace contains the GET message for the Bill or Rights?

The browser only sent one HTTP GET request. Packet number 22 contains the GET message.

13. Which packet number in the trace contains the status code and phrase associated with the response to the HTTP GET request?

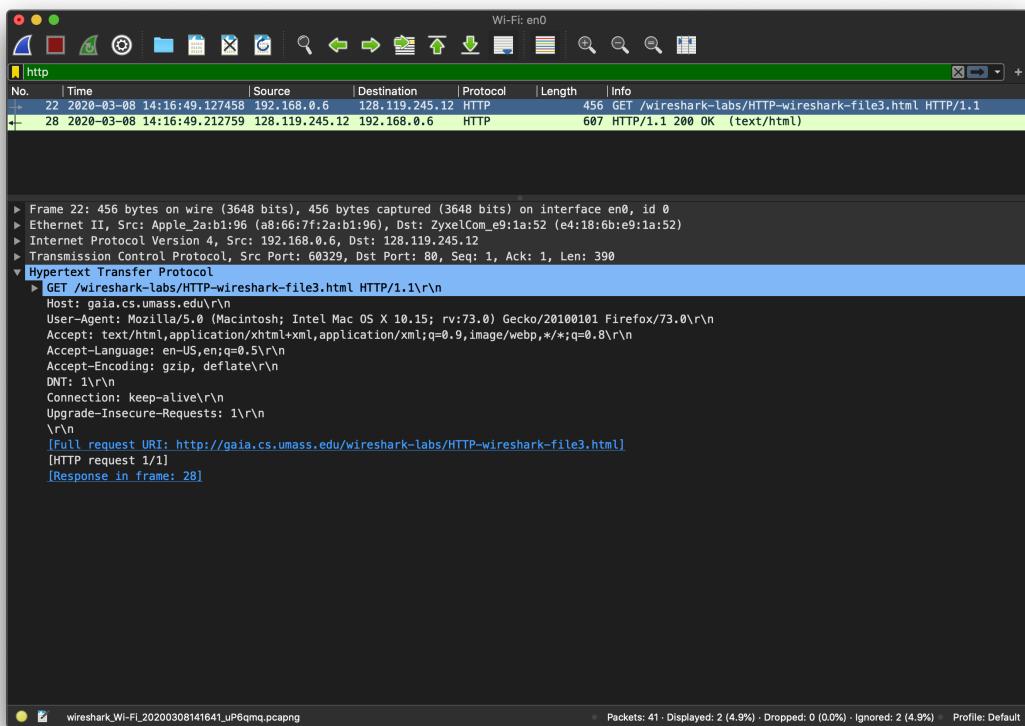
Packet 28 contains the status code and phrase associated with the response.

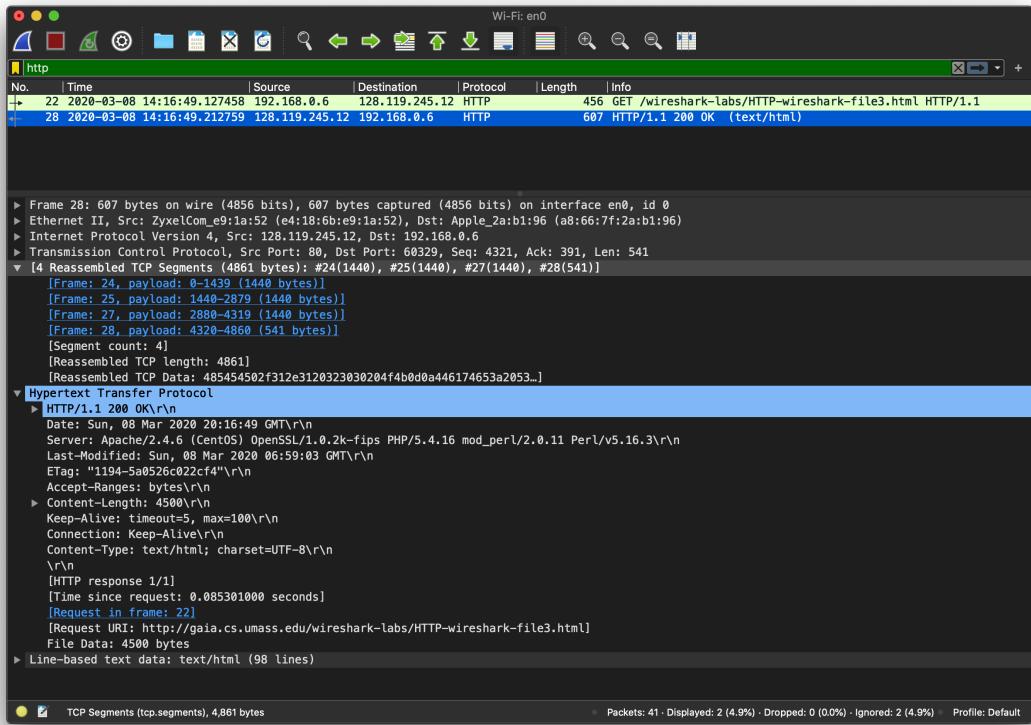
14. What is the status code and phrase in the response?

200 OK

15. How many data-containing TCP segments were needed to carry the single HTTP response and the text of the Bill of Rights?

Four TCP segments were needed to carry the response and text.





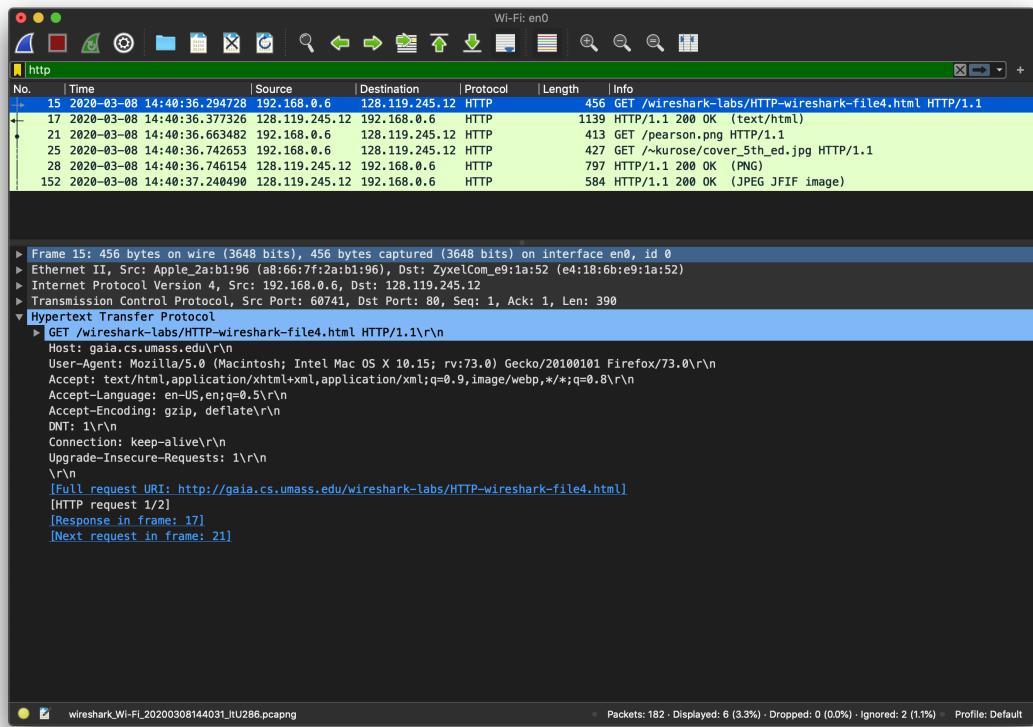
## 4. HTML Documents with Embedded Objects

16. How many HTTP GET request messages did your browser send? To which Internet addresses were these GET requests sent?

There are three HTTP GET requests. In my trace, all three were sent to the same IP address: 128.119.245.12.

17. Can you tell whether your browser downloaded the two images serially, or whether they were downloaded from the two web sites in parallel? Explain.

It appears that both images were downloaded in parallel as both requests were placed, then both images were received, as opposed to requesting one, receiving one, then requesting the second, receiving the second.



## 5. HTTP Authentication

18. What is the server's response (status code and phrase) in response to the initial HTTP GET message from your browser?

401 Unauthorized

19. When your browser sends the HTTP GET message for the second time, what new field is included in the HTTP GET message?

Authorization: Basic d2lyZXNoYXJrLXN0dWR1bnRzOm5ldHdvcms=

Credentials: wireshark-students:network

Wi-Fi: en0

No.	Time	Source	Destination	Protocol	Length	Info
12	2020-03-08 15:22:42.513959	192.168.0.6	128.119.245.12	HTTP	472	GET /wireshark-labs/protected_pages/HTTP-wireshark-file5.htm...
14	2020-03-08 15:22:42.599673	128.119.245.12	192.168.0.6	HTTP	783	HTTP/1.1 401 Unauthorized (text/html)
47	2020-03-08 15:22:49.167801	192.168.0.6	128.119.245.12	HTTP	531	GET /wireshark-labs/protected_pages/HTTP-wireshark-file5.htm...
49	2020-03-08 15:22:49.245781	128.119.245.12	192.168.0.6	HTTP	556	HTTP/1.1 200 OK (text/html)

```

▶ Frame 14: 783 bytes on wire (6264 bits), 783 bytes captured (6264 bits) on interface en0, id 0
▶ Ethernet II, Src: ZyxelCom_e9:1a:52 (e4:18:6b:e9:1a:52), Dst: Apple_2a:b1:96 (a8:66:7f:2a:b1:96)
▶ Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.0.6
▶ Transmission Control Protocol, Src Port: 80, Dst Port: 61501, Seq: 1, Ack: 407, Len: 717
▼ Hypertext Transfer Protocol
  ▶ HTTP/1.1 401 Unauthorized\r\n
    Date: Sun, 08 Mar 2020 21:22:42 GMT\r\n
    Server: Apache/2.4.6 (CentOS) OpenSSL/1.0.2k-fips PHP/5.4.16 mod_perl/2.0.11 Perl/v5.16.3\r\n
    WWW-Authenticate: Basic realm="wireshark-students only"\r\n
  ▶ Content-Length: 381\r\n
  ▶ Keep-Alive: timeout=5, max=100\r\n
  ▶ Connection: Keep-Alive\r\n
  ▶ Content-type: text/html; charset=iso-8859-1\r\n
  \r\n
  [HTTP response 1/1]
  [Time since request: 0.085714000 seconds]
  [Request in frame: 12]
  [Request URI: http://gaia.cs.umass.edu/wireshark-labs/protected_pages/HTTP-wireshark-file5.html]
  File Data: 381 bytes
  ▶ Line-based text data: text/html (12 lines)

▶ Line-based text data: text/html (12 lines)

```

wireshark\_Wi-Fi\_20200308152239\_OpYxIV.pcapng

Packets: 73 · Displayed: 4 (5.5%) · Dropped: 0 (0.0%) · Ignored: 2 (2.7%) · Profile: Default

Wi-Fi: en0

No.	Time	Source	Destination	Protocol	Length	Info
12	2020-03-08 15:22:42.513959	192.168.0.6	128.119.245.12	HTTP	472	GET /wireshark-labs/protected_pages/HTTP-wireshark-file5.htm...
14	2020-03-08 15:22:42.599673	128.119.245.12	192.168.0.6	HTTP	783	HTTP/1.1 401 Unauthorized (text/html)
47	2020-03-08 15:22:49.167801	192.168.0.6	128.119.245.12	HTTP	531	GET /wireshark-labs/protected_pages/HTTP-wireshark-file5.htm...
49	2020-03-08 15:22:49.245781	128.119.245.12	192.168.0.6	HTTP	556	HTTP/1.1 200 OK (text/html)

```

▶ Frame 47: 531 bytes on wire (4248 bits), 531 bytes captured (4248 bits) on interface en0, id 0
▶ Ethernet II, Src: Apple_2a:b1:96 (a8:66:7f:2a:b1:96), Dst: ZyxelCom_e9:1a:52 (e4:18:6b:e9:1a:52)
▶ Internet Protocol Version 4, Src: 192.168.0.6, Dst: 128.119.245.12
▶ Transmission Control Protocol, Src Port: 61502, Dst Port: 80, Seq: 1, Ack: 1, Len: 465
▼ Hypertext Transfer Protocol
  ▶ GET /wireshark-labs/protected_pages/HTTP-wireshark-file5.html HTTP/1.1\r\n
    Host: gaia.cs.umass.edu\r\n
    User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10.15; rv:73.0) Gecko/20100101 Firefox/73.0\r\n
    Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8\r\n
    Accept-Language: en-US,en;q=0.5\r\n
    Accept-Encoding: gzip, deflate\r\n
    DNT: 1\r\n
    Connection: keep-alive\r\n
    Upgrade-Insecure-Requests: 1\r\n
    Authorization: Basic d2lyZNoYJrlXN0dWRlbz0m5ldHdvcms=\r\n
      Credentials: wireshark-students:network
      \r\n
      [Full request URI: http://gaia.cs.umass.edu/wireshark-labs/protected_pages/HTTP-wireshark-file5.html]
      [HTTP request 1/1]
      [Response in frame: 49]

Text Item (text), 72 bytes

```

wireshark\_Wi-Fi\_20200308152239\_OpYxIV.pcapng

Packets: 73 · Displayed: 4 (5.5%) · Dropped: 0 (0.0%) · Ignored: 2 (2.7%) · Profile: Default